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CHARTS OF SELECTED FISHING BANKS IN THE WATERS AROUND AMERICAN SAMOA

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INTRODUCTION

The Western Pacific Regional Fishery Management Council (Council) met in Kona, Hawaii in August 1985. At that time the full Advisory Panel to the Council passed a resolution underscoring the need to develop improved charts of the offshore fishing grounds in American Samoa. Noting that fishing conditions around the main island of Tutuila had deteriorated due to heavy fishing pressure, the Advisory Panel as a whole resolved that the nearshore problem has been exacerbated because existing nautical charts provide sparse coverage of the more distant banks. These are known to be productive but underutilized fishing grounds. The lack of specific information concerning bottom topography at several of American Samoa's offshore banks is believed damaging to the local economy because the potential of these areas is not fully realized. Increasing the harvest of offshore resources would help relieve the pressure on nearshore areas. The Advisory Panel expressed the opinion that more detailed knowledge of the bathymetry of these offshore banks would encourage their exploitation by providing information about their size and location to the local fleet.

The opportunity to address these concerns soon became a reality when the NOAA ship Townsend Cromwell was scheduled to undertake an albacore survey in surface waters of the southern Subtropical Convergence during the months of January and February 1986. In view of the Advisory Panel resolution it was decided that the vessel would stop and spend several days developing bathymetric charts of some of the offshore fishing grounds around American Samoa. This report summarizes the findings of that study.

DESCRIPTION OF STUDY SITE

Before arrival of the Townsend Cromwell consulations were held with personnel at the Office of Marine Resources in Pago Pago, American Samoa to determine the general locations of the offshore banks to be surveyed. Based on these discussions five sites were tentatively identified for which unregistered reconnaissance hydrographic surveys would be carried out. These were:

Location		Latitude	Longitude
Bank 1	South Bank	14°81'-14°94'S	170°53'-170°71'W
Bank 2	East Bank	14°26'-14°38'S	170°10'-170°44'W
Bank 3	Southeast Bank	14°44'-14°56'S	169°97'-170°09'W
Bank 4	Northeast Bank	13°99'-14°09'S	170°01'-170°14'W
Bank 5	Manua Group	14°19'-14°25'S	169°52'-169°55'W

The locations of the five survey areas relative to the main island of Tutuila and the three islands of the Manua Group are shown in Figure 1.

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METHODS

The Townsend Cromwell is equipped with Raytheon and Simrad depth sounders and a variety of electronic navigational aids. In this study bathymetric surveys were carried out to at least a depth of 935-1,122 m (500-600 fathoms) using the ship's Raytheon fathometer because of its superior performance when sounding over deep water. Precise navigational control was, however, a major problem throughout. Although the vessel has functioning Loran, Omega, and Satellite navigational systems, there were problems with each. Loran C signals are unavailable in the waters around American Samoa. Omega, although available during surveys, does not provide highly accurate navigational fixes. Moreover, while accurate positions are known at the time of an update, Satellite fixes are only periodically available, i.e., about once every 70 min during the surveys reported on here. During the interim adverse current and wind conditions set the vessel as much as 2.5 nmi from its estimated position.

To alleviate all of these problems a Global Positioning System (GPS) was acquired specifically for use during the cruise. The specifications of this unit allow fixes to within 200 m at any time of day and at any point on the globe. Although a GPS unit was transported to Pago Pago and was successfully installed, it failed to function while at sea. All navigational fixes were therefore obtained using a Magnavox Satellite Navigational System, augmented by Omega for interim position projections (NAV2 option). Major errors in navigational control were unavoidable using this system. As indicated previously, wind and currents often set the vessel as much as 2.5 nmi off its estimated position in a span of 60-90 min. Consequently, all results presented herein must be considered preliminary and in need of confirmation.

During surveys the vessel typically ran predefined east-west tracks at a speed of 8 kn. Sequential tracks were spaced at distances of anywhere from 0.25 to 0.50 nmi apart in the north-south direction. During transit on a track line soundings were taken every minute and positions were recorded every 2 min. A few randomly spaced north-south crosslines were run across the main east-west tracks to provide additional data and to check for errors in navigational control by comparing soundings obtained at the intersections of lines. Corrections for the draft of the vessel (3.4 m) were not applied to the sounding data. Similarly, no corrections to depth were determined or applied to the data for velocity of sound through water, variation in instrument belt tension, wave effects, or the vessel's motion while underway.

Survey data were recorded by hand in a logbook (sounding volume) and were entered onto the Honolulu Laboratory's Molecular computer upon completion of the cruise. The data were first edited for errors and verified. Because positions were lacking for every other sounding record, these were estimated by interpolation using the positions given in the records preceding and following an observation whose position was missing. The file was transferred to the University of Hawaii's DEC 2065 computer and DISSPLA, a contouring software package, was used to analyze the data and to prepare contour maps. A bicubic spline interpolation routine called

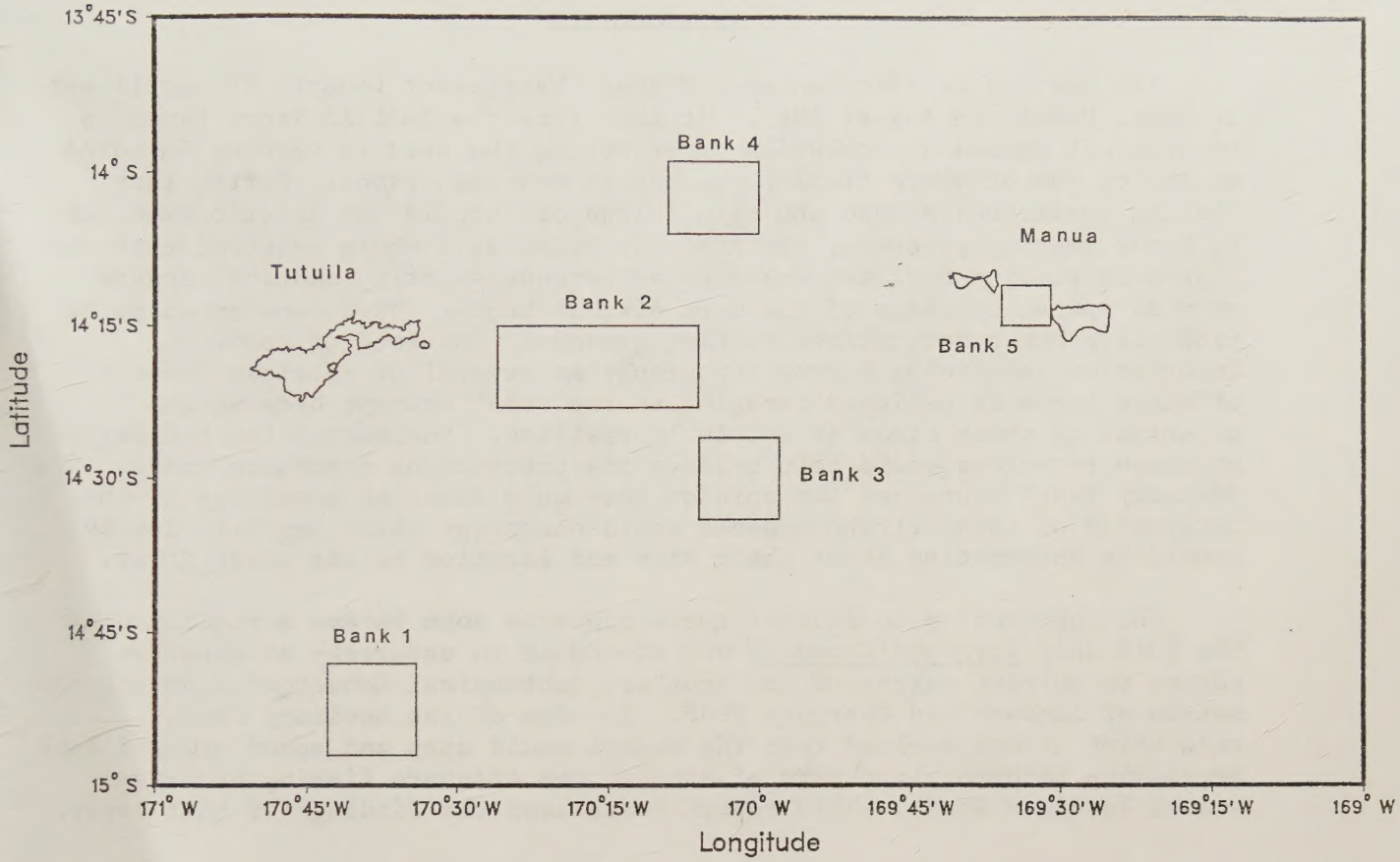

Figure 1.--Locations of the five survey areas relative to Tutuila and the islands of the Manua Group.

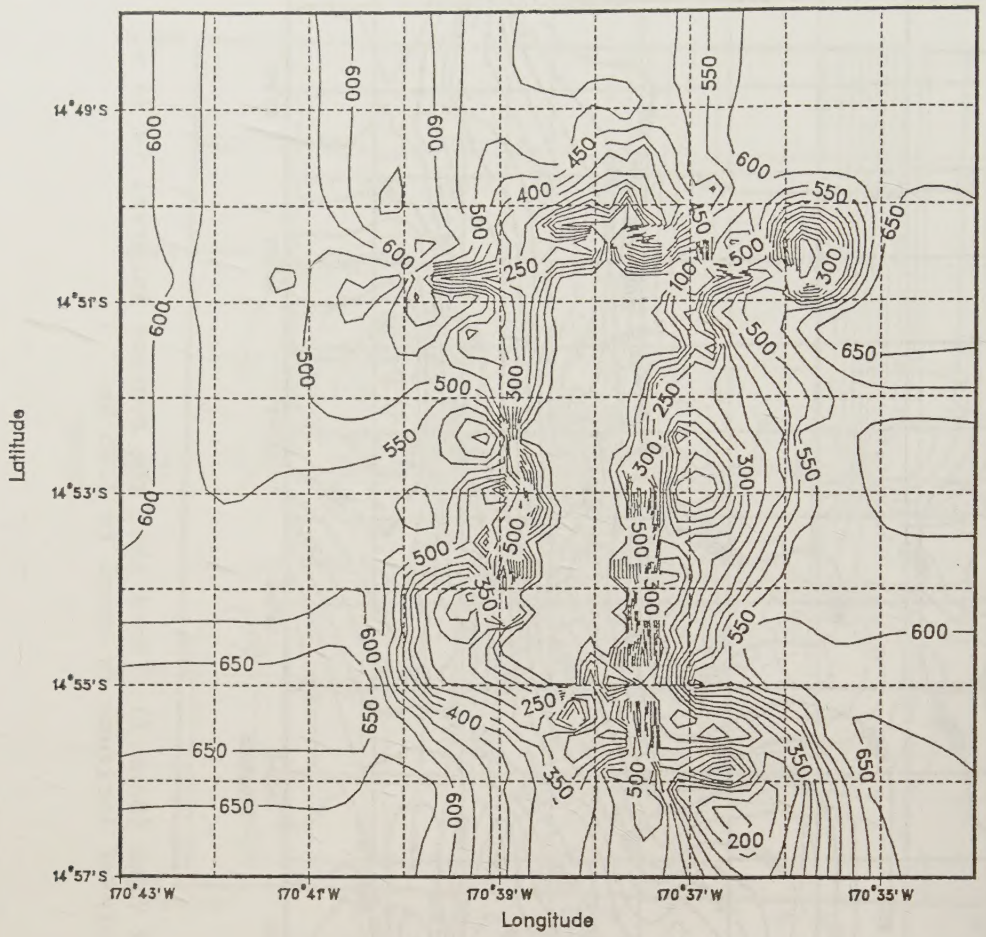

Figure 2.--Bathymetric contours of the South Bank (Bank 1). Note that the contour interval is 94 m (50 fathoms) and 1.0 min of latitute is equal to 1.85 km.

SPLOT smoothed the irregularly spaced data points and produced three dimensional models of the ocean floor. Each model was cut at 94-m (50-fathom) depth intervals to produce contour plots. Contour lines closer than 0.8 mm (1/32") were thinned to enhance readability. Mapping distortions are taken into consideration using DISSPLA's ability to generate standard Mercator projections. All plots were proportionally developed, but each was scaled to maximize page surface area.

RESULTS

The Townsend Cromwell departed Pago Pago Harbor, American Samoa on January 22, 1986 to begin the series of unregistered reconnaissance hydrographic surveys. The vessel returned to harbor on January 27 after spending 5 days performing nothing but bathymetric work. During this time 2,007 depth soundings were taken over deep-sea shrimp and bottom fish grounds 94-1,122 m (50-600 fathoms). The numbers of soundings collected at each of the five study sites were as follows:

Location		Number of soundings
Bank 1	South Bank	739
Bank 2	East Bank	500
Bank 3	Southeast Bank	238
Bank 4	Northeast Bank	258
Bank 5	Manua Group	272

Charts were prepared for each of these five areas and are presented in Figures 2-6, respectively. Note that in each the grid pattern reflects 1 x 1 min quadrants and that, for scale, 1 min of latitude = 1 nmi = 1.85 km. The following are selected notes about each of the survey areas.

South Bank (Bank 1)

Navigational difficulties were particularly acute during the survey of this area. Extreme position shifts (in excess of 1.0 nmi) were a common occurrence whenever the Satellite navigation unit received an update. Because of this, the initial contour plot of the South Bank showed a disjunct pattern wherein the northern quarter of the bank was shifted approximately 2.0 nmi to the west-northwest. The raw data showed this was due to several position shifts of track lines acquired during the survey of the north end. The data were adjusted by vector addition of the recorded position and the NAV2 set and drift vector in an attempt to account for position error. The resulting plot is presented in Figure 2.

The chart shows that South Bank is roughly 4.5 nmi long and 1.0 nmi wide. The top of the bank appears to be largely a flat surface 37 m (20 fathoms) deep. The bottom slopes steeply away on all sides to a depth of 1,122 m (600 fathoms).

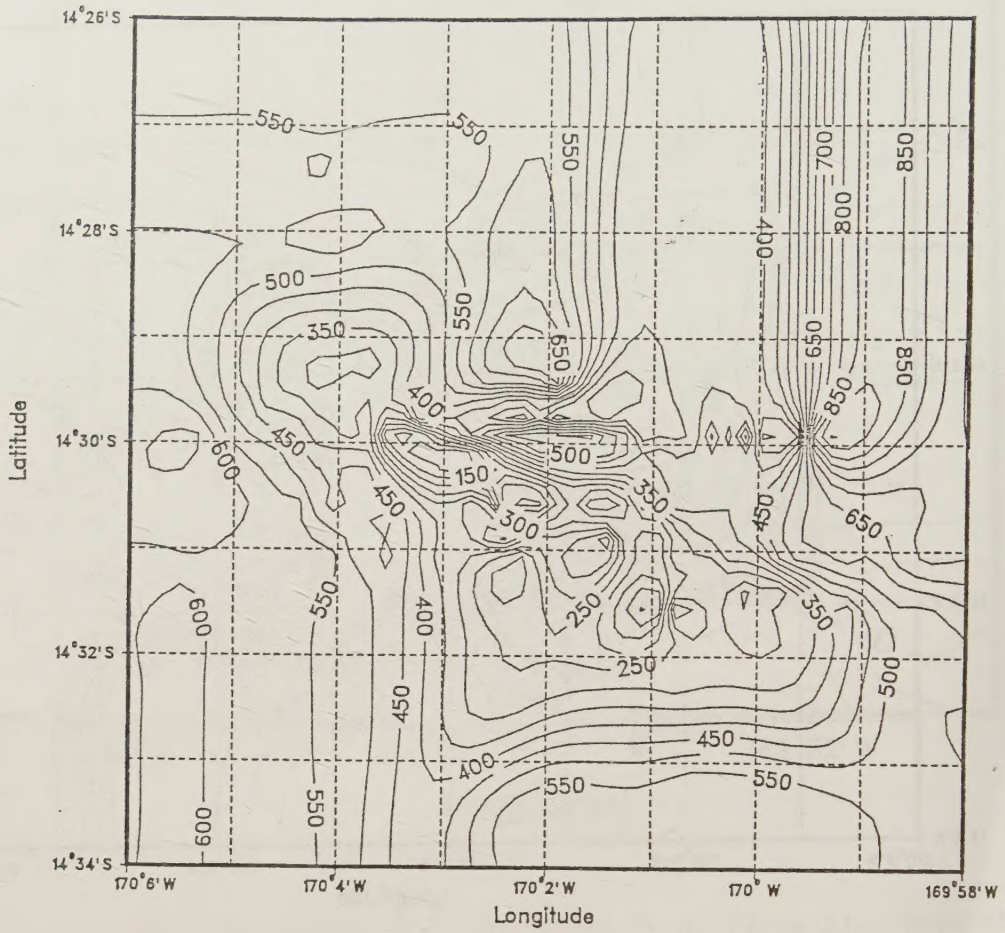

Figure 4.--Bathymetric contours of the Southeast Bank (Bank 3). Note that the contour interval is 94 m (50 fathoms) and 1.0 min of latitude is equal to 1.85 km.

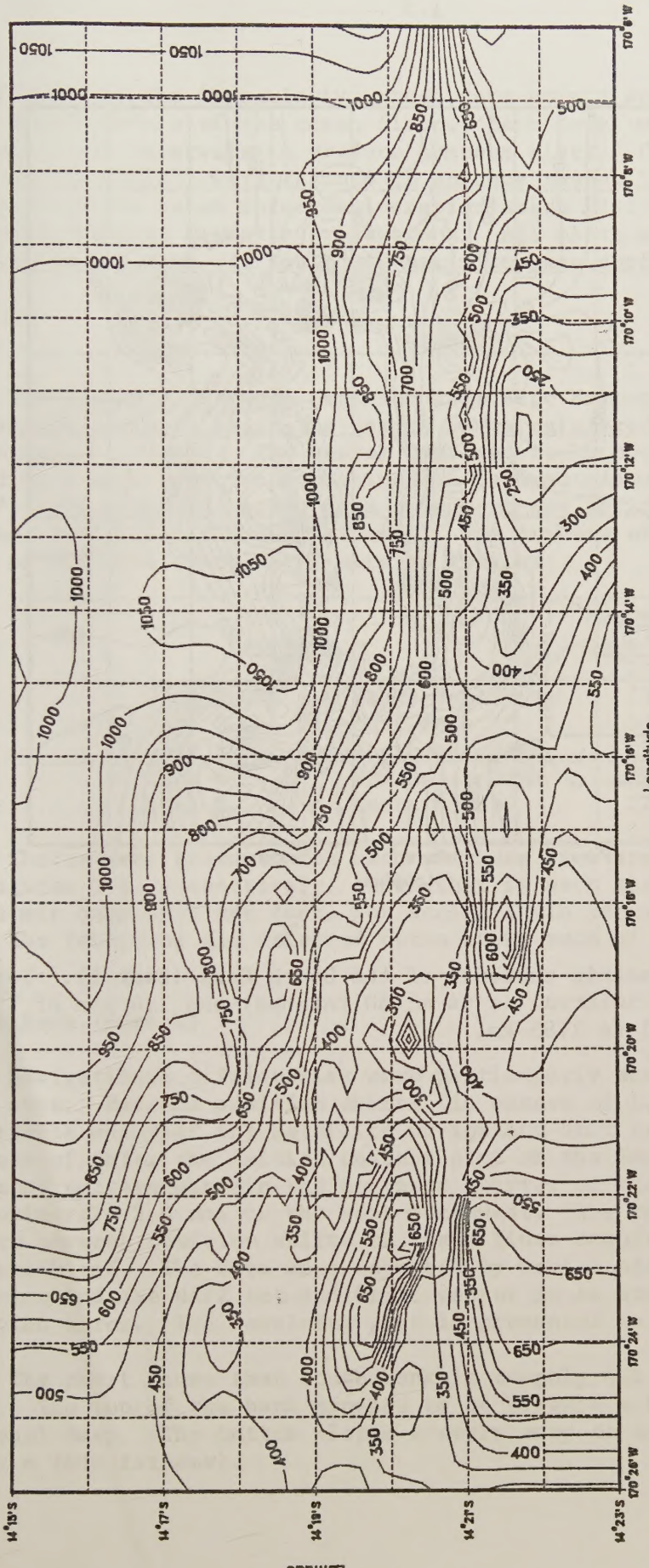

Figure 3.—Bathymetric contours of the East Bank (Bank 2). Note that the contour interval is 94 m (50 fathoms) and 1.0 min of latitude is equal to 1.85 km.

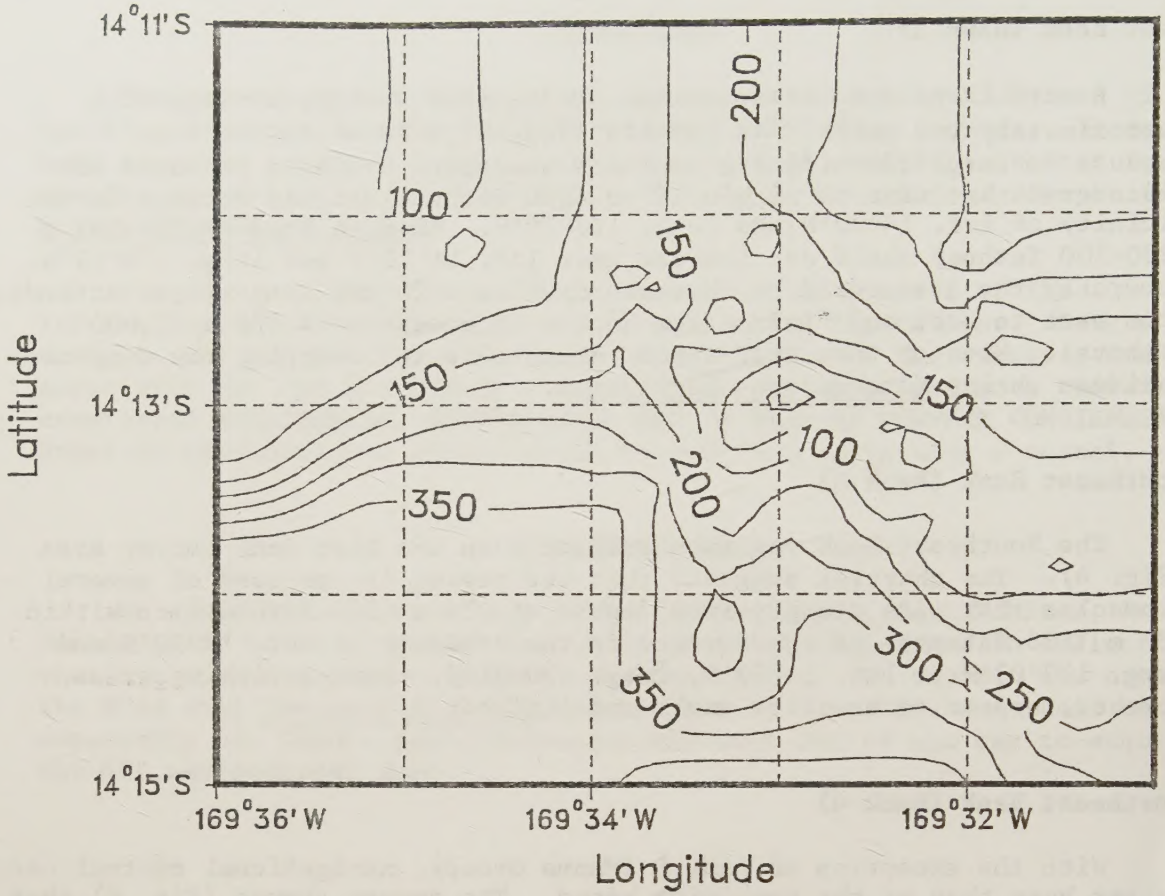

Figure 6.--Bathymetric contours of the Manua Group (Bank 5). Note that the contour interval is 94 m (50 fathoms) and 1.0 min of latitude is equal to 1.85 km.

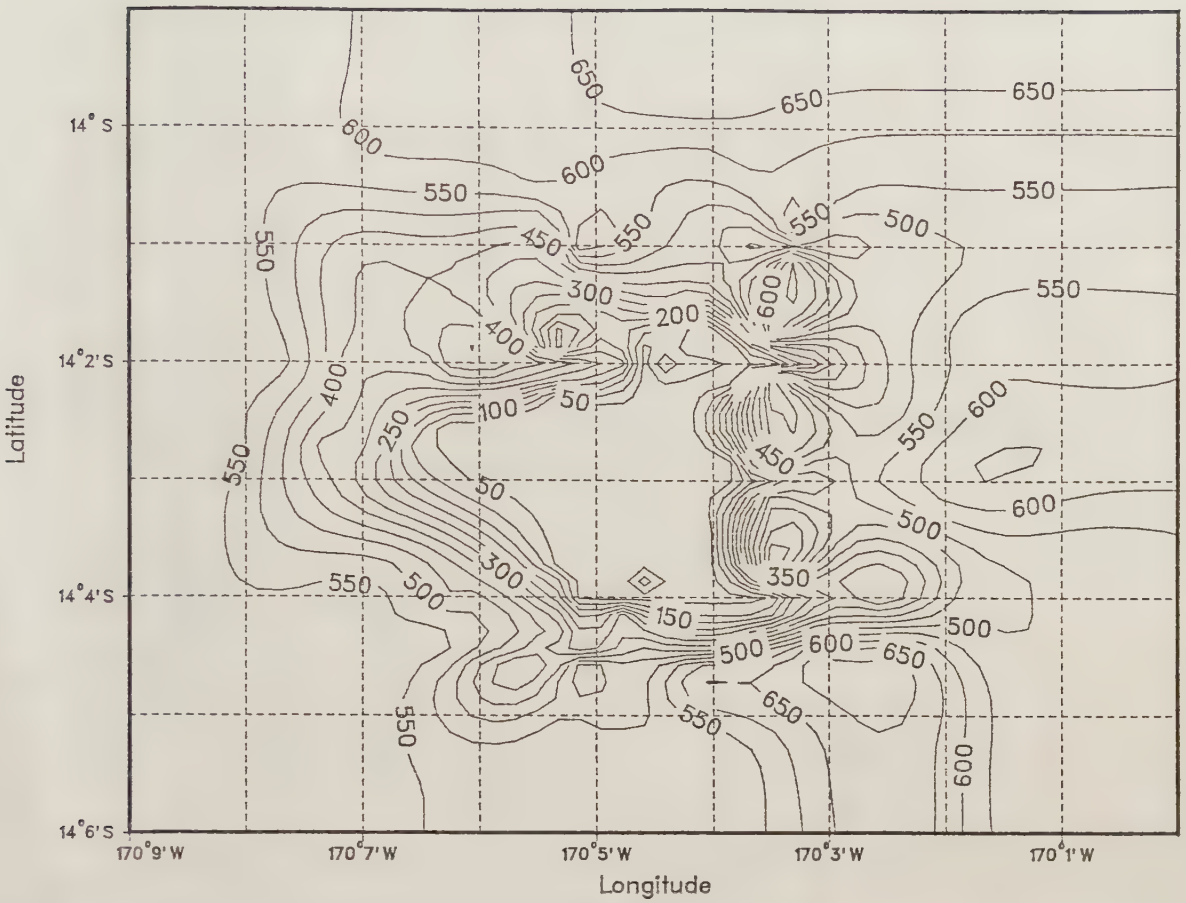

Figure 5.--Bathymetric contours of the Northeast Bank (Bank 4). Note that the contour interval is 94 m (50 fathoms) and 1.0 min of latitude is equal to 1.85 km.

DISCUSSION

The information presented here may be useful to the fishermen of American Samoa in locating new and productive fishing grounds. It may also help resource managers to estimate the extent of available habitat for species demonstrating developmental potential. One obvious example is Heterocarpus laevigatus.

On a more cautious note it is imperative that user's of the information contained in this report realize its limitations. Severe navigational problems were encountered during all of the surveys, and especially for the South Bank. All five of the chartlets must therefore be considered **PRELIMINARY, APPROXIMATE, AND IN NEED OF FURTHER CONFIRMATION.** Under no circumstances should these be used for navigating a vessel.

ACKNOWLEDGMENTS

We would like to thank Ray Buckley, Dave Itano, Bert Kikkawa, Mel Makaiwi, and Gordon Yamasaki for their cheerful assistance in collecting the data that was used to prepare the chartlets. The captain and crew of the NOAA ship Townsend Cromwell are also to be commended for their help, especially Lt. Comdr. David McConaghy who went out of his way to acquire the GPS navigational unit.

East Bank (Bank 2)

A very large area was examined during this survey, encompassing approximately 160 nmi^2. The results (Fig. 3) were disappointing because no large identifiable bank was located. A single pinnacle was discovered that came to within 187 m (100 fathoms) of the surface in the vicinity of lat. 14°20'N and long. 170°20'W. Also, a broader 374-561 m (200-300 fathom) shelf was located near lat. 14°22'N and long. 170°12'W. Generally the area could be characterized as a 20-nmi long ridge, extending from east to west and rising from depths in excess of 1,870 m (1,000 fathoms). Much of this area appeared suitable for trapping the deepwater caridean shrimp Heterocarpus laevigatus.

Southeast Bank (Bank 3)

The Southeast Bank was much smaller than the East Bank survey area (Fig. 4). The chartlet suggests that the region is composed of several pinnacles that rise steeply from depths of 935 m (500 fathoms) to within 187 m (100 fathoms) of the surface in the vicinity of lat. 14°30'N and long. 170°03'W to lat. 14°32'N, long. 170°01'W. Actual fishing areas, however, appear to be quite small and limited.

Northeast Bank (Bank 4)

With the exception of Bank 5 (Manua Group), navigational control was better here than at the remaining sites. The survey showed (Fig. 5) that the Northeast Bank, situated at lat. 14°03'N and long. 170°05'W, is a flat-topped guyot, rising from 1,122 m (600 fathoms) to within 94 m (50 fathoms) of the surface. The top of the bank has an area slightly in excess of 3 nmi^2 and the sides slope steeply away in all directions.

Manua Group (Bank 5)

The last survey location was situated in mid-channel between the islands of Olosega and Tau in the Manua Group of American Samoa. This site is popular with the fishermen of that area, who requested the survey to gain greater knowledge about the bathymetry of their fishing ground.

Navigational control during this survey was achieved using radar. The vessel was sufficiently close to fixed landmarks that position fixes could be obtained more accurately by this method.

The results showed that the survey area consists of a submarine ridge running northwest-southeast (Fig. 6). A number of pinnacles were located in the area which varied in least depth from 94 to 561 m (50 to 300 fathoms). Observations made on the vessel's chromoscope during the survey revealed the presence of what appeared to be aggregations of Etelis coruscans, a deepwater snapper, in the 187-280 m (100-150 fathom) depth zone.

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